(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 821 153 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
28.01.1998 Bulletin 1998/05

(21) Application number: 97902668.9

(22) Date of filing: 13.02.1997

(51) Int. Cl.[6]: F02M 37/12

(86) International application number:
PCT/JP97/00375

(87) International publication number:
WO 97/30283 (21.08.1997 Gazette 1997/36)

(84) Designated Contracting States:
IT

(30) Priority: 14.02.1996 JP 50936/96
03.02.1997 JP 35491/97

(71) Applicant:
MIKUNI ADEC CORPORATION
Iwate-gun, Iwate 020-01 (JP)

(72) Inventors:
- OIKAWA, Kenichi
Saitama 336 (JP)
- CHIBA, Noriaki
Iwate 020-01 (JP)
- TERADA, Hideo
Tochigi 329-21 (JP)
- MATUZAKA, Rui
Iwate 020 (JP)

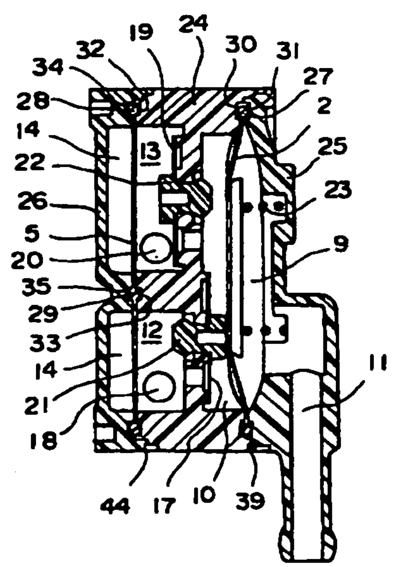
(74) Representative:
Bazzichelli, Alfredo et al
c/o Società Italiana Brevetti S.p.A.
Piazza di Pietra, 39
00186 Roma (IT)

(54) DIAPHRAGM-HOLDING SYNTHETIC RESIN ASSEMBLY

(57) An O-ring shaped annular rib 63 is disposed around the outer periphery of a flexible diaphragm member 62, and grooves 70 and 71 are formed for receiving the annular rib 63 in the hollow space in the compressed state wherein the foregoing hollow space is defined between a first synthetic resin member 60 for holding the diaphragm 62 in the clamped state and a second synthetic resin member 61. While the annular rib 63 is received in each of the grooves 70 and 71, a location 64 where the first synthetic resin member 60 and the second synthetic resin member 61 come in contact with each other at the positions located outward of the grooves 70 and 71 is subjected to welding with the aid of a supersonic welding tool 65.

A gap 76 is formed between the first synthetic resin member 60 and the supersonic welding tool 65, and this gap 76 is caused to disappear by progressively performing a welding operation. At this time, further proceeding of the welding operation is inhibitively suppressed by allowing the first synthetic resin member 60 and the supersonic welding tool 65 to come in contact with each other, and the compression rate specified for the annular rib 63 is kept constant. Alternatively, a metallic spacer 77 is interposed between the first synthetic resin member 60 and the second synthetic resin member 61. In this case, a gap 78 is formed in the hollow space defined by the second synthetic resin member 61 and the metallic spacer 77 prior to a welding operation, and this gap 78 is caused to disappear as the welding operation is progressively performed so as to allow further proceeding of the welding operation to be inhibitively suppressed. At this time, the compression rate specified for the annular rib 63 is kept constant.

FIG. 1



EP 0 821 153 A1

Description

[TECHNICAL FIELD]

The present invention relates to a synthetic resin assembly having diaphragm(s) clamped wherein members each serving to hold a flexible diaphragm member in the clamped state is molded of a resin material, and these members are welded together.

[BACKGROUND ART]

A diaphragm type fuel pump adapted to operate under the influence of pulsative pressure generated in a crankcase or in a suction tube is hitherto known. Here, the structure of a conventional diaphragm type fuel pump will be described below with reference to Fig. 17. A first cover 4 including a first flexible diaphragm member 2 and an annular gasket 3 in the clamped state is arranged on one side surface of a pump casing 1, and a second cover 7 including a second flexible diaphragm member 5 and a gasket 5 in the clamped state is arranged on the other side surface of the pump casing 1. While the first flexible diaphragm member 2 and the annular gasket 3 are held between the pump casing 1 and the first cover 4 in the clamped state, and moreover, the second flexible diaphragm member 5 and the gasket 5 are held between the pump casing 1 and the second cover 7 in the clamped state, these members are immovably held by tightening a plurality of bolt members 8. Usually, the first flexible diaphragm member 2 and the second flexible diaphragm member 5 are constructed by using a rubber membrane having a base fabric involved therein. However, there arises an occasion that the first flexible diaphragm 2 and the second flexible diaphragm 5 are constructed by using a resin membrane, and in this case, the gasket 3 is additionally held between the pump casing 1 and the first flexible diaphragm member 2 in the clamped state, and moreover, the gasket 6 is additionally held between the pump casing 1 and the second flexible diaphragm member 5 in the clamped state (consequently, four gaskets in total are arranged in the fuel pump in the clamped state).

A pulsation chamber 9 is formed between the first flexible diaphragm member 2 and the first cover 4, and moreover, a pump actuating chamber 10 is formed between the pump casing 1 and the first flexible diaphragm member 2. A certain intensity of pulsation pressure generated in an engine is introduced into the pulsation chamber 9 via an introduction passage 11. Further, a fuel suction chamber 12 and a fuel discharge chamber 3 are formed between the pump casing 1 and the second flexible diaphragm member 5, and moreover, an air chamber 14 corresponding to the fuel suction chamber 12 and the fuel discharge chamber 13 is formed between the second flexible member 5 and the second cover 7. With such construction, fuel is introduced into the fuel suction chamber 12 via a fuel inflow hole 15, and fuel is caused to flow out of the fuel pump via a fuel discharge hole 16.

The pump actuating chamber 10 and the fuel suction chamber 12 are communicated with each other via a fuel passage 18 having a suction valve 17 disposed therein, while the pump actuating chamber 10 and the fuel discharge chamber 13 are communicated with each other via a fuel passage 20 having a discharge valve 19 disposed therein. The suction valve 17 serving to open the fuel passage 1 is attached to a grommet 21, and additionally, this grommet 21 is attached to the pump casing 1 in such a manner as to enable it to move relative to the pump casing 1. In addition, the discharge valve 19 serving to open the fuel passage 20 is attached to a grommet 22, and this grommet 22 is attached to the pump casing 1 in such a manner as to enable it to move relative to the pump casing 1. A coil spring 23 for biasing the first flexible diaphragm member 2 in such a direction as to allow the pulsation chamber 9 to be expanded is received in the pulsation chamber 9. In dependence on the nature of the pulsation pressure introduced into the pulsation chamber 9 from the crankcase, there arises an occasion that this coil spring 23 is used, and alternately, there arises an occasion that the coil spring 23 is not used.

With respect to the conventional diaphragm type fuel pump shown in Fig. 17, die cast products obtained by using aluminum or a similar metallic material by practicing a die casting process are generally used for the pump casing 1 and the first cover 4. When there arises a malfunction that a phenomenon of vapor locking appears as fuel (especially, gasoline) receives the heat generated in the engine, there occurs an occasion that a resin material having excellent thermal insulation is used for the pump casing 1 and the first cover 4. In this case, since there arises a malfunction that creep deformation occurs on the pump casing 1 and the first cover 4 as a plurality of bolt members 8 are tightened when a thermal plastic material is used, a thermosetting resin is used for the pump casing 1 and the first cover 4. However, the thermosetting resin has poor productivity. In fact, a thermosetting resin exhibiting few creep deformation is available but it is difficult to use this material on the economically acceptable basis for the reason that it is expensive.

Another problem inherent to the conventional diaphragm fuel pump consists in the fact that the annular gasket 3 and the gasket 6 adapted to be held together with the first flexible diaphragm member 2 and the second flexible diaphragm member 5 in the clamped state are expensive. In addition, since the first flexible diaphragm member 2 and a single or two annular gaskets are clamped between the pump casing 1 and the second cover 4, the second flexible diaphragm member 5 and a single or two gaskets 6 are clamped between the pump casing 1 and the second cover 7, and finally, these members are tightened in the superimposed state, the conventional diaphragm type fuel pump is

unavoidably produces an increased cost attributable to the increased man-hours required for assembling the aforementioned members.

The present invention has been made in consideration of the drawbacks inherent to the conventional diaphragm type fuel pump as mentioned above in order to eliminate the foregoing drawbacks. Therefore, an object of the present invention is to provide a synthetic resin assembly having diaphragm member(s) clamped wherein any creep deformation is not induced even though an inexpensive material of thermoplastic resin is used for a main body, a first cover and a second cover, gaskets hitherto used for the conventional diaphragm type fuel pomp are not required, and the number of man-hours required for constructing the diaphragm type fuel pump can be reduced.

In addition, another object of the present invention is to provide a synthetic resin assembly having diaphragm member(s) clamped wherein excessive proceeding of each welding operation at a welding location is inhibitively suppressed when two synthetic resin members are welded together, and moreover, compression of each annular rib formed around the peripheral part of each diaphragm member in excess of a predetermined constant compression rate is reliably prevented.

[DISCLOSURE OF THE INVENTION]

According to the present invention, there is provided a synthetic resin assembly having diaphragm member(s) clamped wherein a flexible diaphragm member is clamped between two members, and the diaphragm member(s) for forming a hollow space are clamped between one member and one flexible diaphragm member, wherein a resin material is used for the two members, an annular rib is formed around the outer periphery of the flexible diaphragm member, a groove for receiving an annular rib for the flexible diaphragm member in the compressed state on at least one of the two members, and the two members are welded together around the whole peripheral edge of the groove while the annular rib is received in the groove.

In addition, according to the present invention, the synthetic resin assembly is constructed such that a surface held in the state isolated from a supersonic welding tool is formed on one synthetic resin member prior to a welding operation, and then, as the welding operation is progressively performed, the supersonic welding tool and the foregoing surface are brought in contact with each other so as to allow further proceeding of the welding operation to be inhibitively suppressed, and moreover, the compression rate specified for the annular rib is kept constant.

Additionally, according to the present invention, the synthetic resin assembly is constructed such that a metallic spacer is interposed between two synthetic resin members, hollow spaces are formed for one synthetic resin member as well as for the metallic spacer, the hollow spaces are caused to disappear as the supersonic welding operation is progressively performed, further proceeding of the supersonic welding operation is inhibitively suppressed by allowing the metallic spacer to come in contact with one synthetic resin member, and moreover, the compression rate specified for the annular rib is kept constant.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a sectional view of a synthetic resin assembly having diaphragm members clamped wherein the synthetic resin assembly is constructed for a diaphragm type fuel pump in accordance with an embodiment of the present invention.

Fig. 2 is a plan view showing the contour of a rib for a first flexible diaphragm member.

Fig. 3 is a plan view showing the contour of a rib for a second flexible diaphragm member

Fig. 4 is a fragmentary sectional view of the synthetic resin assembly shown in Fig. 1 wherein a joint portion between a main body and a cover is illustrated in the drawing in an enlarged scale.

Fig. 5 is a fragmentary sectional view of the joint portion between the main body and a first cover or a second cover for the synthetic resin assembly shown in Fig. 1 wherein the joint portion is illustrated in the state prior to a jointing operation in an enlarged scale.

Fig. 6 is a fragmentary sectional view of the joint portion between the main body and the first cover or the second cover for the synthetic resin assembly shown in Fig. 1 wherein the joint portion is illustrated in an enlarged scale in accordance with other embodiment of the present invention.

Fig. 7 is a fragmentary view showing the contour of a rib forming portion in an enlarged scale in the case that a resin diaphragm is used as a flexible diaphragm member.

Fig. 8 is a plan view showing the state before a rib for a first flexible diaphragm member having a resin diaphragm used therefor is formed on the first flexible diaphragm member.

Fig. 9 is a plan view showing the state before a rib for a second flexible diaphragm member having a resin diaphragm used therefor is formed on the second flexible diaphragm member.

Fig. 10 is a sectional view of a synthetic resin assembly having a diaphragm member clamped for a negative type fuel cock wherein one example of the synthetic resin assembly is illustrated in the drawing.

Fig. 11 is a fragmentary sectional view showing in an enlarged scale the state that a welding operation is completed for the synthetic resin assembly having a diaphragm member clamped according to the

present invention.

Fig. 12 is a fragmentary sectional view showing the synthetic resin assembly in an enlarged scale wherein an essential part of the synthetic resin assembly is illustrated with r spect to the state prior t completion of th welding operation in accordance with the foregoing embodiment of the present invention.

Fig. 13 is a fragmentary sectional view showing the synthetic resin assembly in an enlarged scale wherein the foregoing essential part of the synthetic resin assembly is illustrated with respect to the state assumed on completion of the welding operation with some deformation induced from the state shown in Fig. 12.

Fig. 14 is a fragmentary sectional view showing the synthetic resin assembly in an enlarged scale wherein the foregoing essential part of the synthetic resin assembly is illustrated with respect to the state assumed prior to a welding operation in accordance with other embodiment of the present invention.

Fig. 15 is a fragmentary sectional view showing the synthetic resin assembly in an enlarged scale wherein the foregoing essential part of the synthetic resin assembly is illustrated with respect to the state assumed after completion of the welding operation in accordance with the other embodiment of the present invention.

Fig. 16 is a fragmentary sectional view showing the synthetic resin assembly in an enlarged scale wherein the foregoing state of the synthetic resin assembly is illustrated with respect to the state assumed after completion of the welding operation in accordance with another embodiment of the present invention.

Fig. 17 is a sectional view showing the structure of a conventional diaphragm pump.

[BEST MODE FOR CARRYING OUT THE INVENTION]

The present invention will be described in detail hereinafter with reference to the accompanying drawings. Fig. 1 is a sectional view showing a synthetic resin assembly having a diaphragm member clamped in accordance with an embodiment of the present invention. Fig. 1 shows a diaphragm type fuel pump. Same reference numerals as those shown in Fig. 17 designate same members or components.

A first flexible diaphragm member 2 is clamped between one side surface of a pump casing 24 and a first cover 25, and a second flexible diaphragm member 5 is clamped between other side surface of the pump casing 24 and a second cover 26. Each of the pump casing 24, the first cover 25 and the second cover 26 is molded of a synthetic resin.

As shown in Fig. 2, an O-ring shaped annular rib 27 molded of an elastic material is formed around the outer periphery of the flexible diaphragm member 2 over both the surfaces of the first flexible diaphragm member 2. In addition, as shown in Fig. 3, an O-ring shaped annular rib 29 molded of an elastic material is formed around the second flexible diaphragm member 5 over both the outer peripheral surfaces of the second flexible diaphragm member 5, and moreover, an O-ring shaped transverse rib 29 transversely extending from the annular rib 28 in the diametrical direction is formed on the annular rib 28. Referring to Fig. 1 again, a fuel suction chamber 12 and a fuel discharge chamber 13 are defined by the transverse rib 29, and at the same time, an air chamber 14 is also defined by the transverse rib 29. As shown in Fig. 4, each of the first flexible diaphragm member 2 and the second flexible diaphragm member 5 is constructed by a robber membrane having a cloth layer involved therein.

As shown in Fig. 1 and Fig. 5, a groove 30 and a groove 31 are formed on the surface of the pump casing 24 as well as on the surface of the first cover 25 so as to allow the annular rib 27 extending around the outer peripheral edge of the first flexible diaphragm member 2 to be received therein in the compressed state. In addition, grooves 32, 33 and grooves 34 and 35 are formed on the surface of the pump casing 24 as well as on the surface of the second cover 26 so as to allow ribs 28 and 29 of the second flexible member 5 to be received therein in the compressed state.

As shown in Fig. 5, an inclined surface 36 is formed on the pump casing 24 in order to come in contact with the first cover 25 (second cover 26). A rounded outer peripheral portion 37 is formed on the first cover 25 (second cover 26) so as to come in contact with the inclined surface 36 of the pump casing 24. In addition, as shown in Fig. 1 and Fig. 4, a welding surface 39 (44) is formed by welding the contact portion so as to allow the rounded peripheral portion 37 to come in contact with the inclined surface 16 (a welding method employed for welding the welding surface 39 (44) will be described later). The pump casing 24, the first cover 25 and the second cover 26 are welded together by forming the welding surface 39 (44).

In addition, as shown in Fig. 5, a surface 40 located opposite to the first cover 25 (second cover 26) is formed on the pump casing 24 between the groove 31 (34) and the inclined surface 36. On the other hand, a surface 41 located opposite to the pump casing 24 is formed on the first cover 25 (second cover 26) between the groove 31 (34) and the outer peripheral part 37. The surface 40 and the surface 41 facing to each other are located not only outside of the groove 30 (31) but also inside of the outer peripheral part 37 and the inclined surface 36 (inclined surface 47). While the pump casing 24 and the first cover 25 (second cover 26) are welded to each other, the surface 40 and the surface 41 facing to each other are designed to assume a gap having a value smaller than zero therebetween.

Additionally, a surface 42 located opposite to the

first cover 25 (second cover 26) is formed on the pump casing 24 inside of the groove 30 (32). On the other hand, a surface 43 located opposite t the surface 42 on the pump casing 24 is formed on the first cover 25 (second cover 26) inside of the groove 31 (34). The surface 42 and the surface 43 facing to each other form a gap larger than zero between the first flexible diaphragm member 2 and the second flexible diaphragm member 5.

In the case that a fuel pump is assembled with the synthetic resin assembly, firstly, the first flexible diaphragm member 2 is clamped between the pump casing 24 and the first cover 25, and moreover, the second flexible diaphragm member 5 is clamped between the pump casing 24 and the second cover 26. Thereafter, the inclined surface 36 on the outside of the groove 31 (34) formed on the first cover 25 (second cover 26) is brought in contact with the outer peripheral part 37 of the groove 31 (34), whereby the resultant contact surface is subjected to welding, for example, by actuating a supersonic welding unit (not shown). As shown in Fig. 1 and Fig. 4, the welded parts defined by inclined surface 36 and the outer peripheral part 37 become welded surfaces 19 and 44. The contour of the jointed part formed between the pump casing 24 and the first cover 25 (second cover 26) should not be limited only to the contour as shown in Fig. 5. Alternatively, for example, the contour as shown in Fig. 6 may be employed. Referring to Fig. 6, a surface 45 facing to the first cover 25 (second cover 26) is formed on the pump casing 24 outside of the groove 30 (32). On the other hand, a surface 46 facing to the surface 45 is formed on the first cover (second cover 26) outside of the groove 31 (34).

Here, the rib 27 extending around the outer peripheral edge of the first flexible diaphragm member 2 is caused to positionally coincide with the groove 31 on the first flexible diaphragm member 2, and moreover, the rib 28 extending around the outer peripheral edge of the second flexible diaphragm member 5 is caused to positionally coincide with the groove 32 on the pump casing 24 and the groove on the second cover 26. Thereafter, the surface 45 of the pump casing 24 and the first cover 25 (second cover 26) are welded together.

When a rubber membrane having a cloth layer involved therein is used for the first flexible membrane member 2 and the second flexible membrane member 5 as shown in Fig. 4, the same material as that of the membrane portion, e.g., NBR (nitrile butadien rubber) is employed for the O-ring shaped ribs 27, 28 and 29 as a material having elasticity in order to assure that the ribs 27, 28 and 29 are supported by the cloth layer involved in the base fabric without any occurrence of a malfunction that they are disconnected from the corresponding flexible diaphragm member.

Incidentally, there arises an occasion that a resin membrane film is used for the first flexible diaphragm member 2 and the second flexible diaphragm member 5. Fig. 7 is an enlarged view showing the outer peripheral part of a resin membrane in the case that resin membranes are used for the first flexible diaphragm member 2 and the second flexible diaphragm member 5. Also in the case that resin membranes are used for the diaphragm members, for example, NBR is typically employed for the ribs 27, 28 and 29 as a material having elasticity. Since the material employed for the diaphragm members is different from the material employed for the ribs, a number of small holes 47 are formed through the first flexible diaphragm member 2 made of a resin membrane at the position where the corresponding rib is arranged, as shown in Fig. 8. With respect to the first flexible diaphragm member made of a resin membrane, a rib 27 is formed by baking the resin membrane from both the surfaces. At this time, a measure is taken for filling a number of hales 47 with NBR or a similar material not only from the front surface side but also from the rear surface side in order to assure that the rib 27 is not disengaged from the diaphragm member. In addition, with respect to the second flexible diaphragm member 5, a number of small holes 48 are formed therethrough at the position where a rib 28 is likewise formed in order to assure that the rib 28 is not disengaged from the second flexible diaphragm member 5, and moreover, a plurality of another small holes 49 are formed through the second flexible diaphragm member 5 at the position where a rib 29 is formed on the second flexible diaphragm member 5 in order to assure that the rib 29 is not disengaged from the second flexible diaphragm member 5, as shown in Fig. 9. Subsequently, for the purpose of practical use, the state as shown in Fig. 8 is shifted to the state as shown in Fig. 2, and moreover, the state as shown in Fig. 9 is shifted to the state as shown in Fig. 3.

The structure of the present invention should not be limited only to a pulsation type fuel pump including two flexible diaphragm members. Of course, the present invention is applicable to a pulsation type fuel pump including a single flexible diaphragm member, and moreover, it is applicable to a lever type fuel pump including a single flexible diaphragm member.

Next, a synthetic resin assembly having a diaphragm member clamped for a negative pressure type fuel cock will be described by way of one example below with reference to Fig. 10. The negative pressure type fuel cock includes a first member 50 composed of a synthetic resin member and a second member 51 composed of a synthetic resin member, and a single diaphragm member 52 is clamped between the first member 50 and the second member 51. An annular rib 53 is formed around the peripheral part of the diaphragm member 52. This annular rib 53 is formed only on the one side of the diaphragm member 52, i. e. , only on the second member 51 side, and an annular groove 54 is formed only on the surface facing to the first member 50 in the second member 51 for receiving the annular rib 53 therein in the compressed state. The concept

that the annular rib 53 serves to maintain airtightness between the int rior of the synthetic resin assembly and the exteri r f the same is same to that in the case shown in Fig. 1. The first member 50 and the second member 51 are welded together by employing a supersonic welding process at a mutual contact location 55 situated outside of the position where the annular rib 53 is received in the annular groove 54 in the compressed state.

The function obtainable from this negative pressure type fuel cock is such that when an engine (not shown) starts this operation, the negative pressure generated by the engine is introduced into a negative pressure chamber 56, the diaphragm member 52 is attractively displaced against the resilient force of a spring 57, and a valve portion 58 formed at the central part of the diaphragm member 52 while sitting on the central part of the diaphragm member 52 is displaced away from the working position, causing a fuel passage 59 to be brought in the communicated state. While the engine continues its operation, the foregoing state is maintained but when the operation of the engine is interrupted, the negative pressure disappears, whereby the valve portion 58 is brought in the sitting state by the resilient force of the spring 57, resulting in the communicated state of the fuel passage 59 being broken. With respect to the synthetic resin assembly having diaphragm member(s) clamped as shown in Fig. 1 and Fig. 10 wherein two synthetic resin members each having a diaphragm member clamped are welded together by employing the supersonic welding process, the airtightness between the interior of the synthetic resin assembly and the exterior of the same is maintained by the annular rib formed around the periphery of each diaphragm member.

When two members each molded of a synthetic resin for clamping a diaphragm member therebetween are welded together by employing the supersonic welding process, there arises a necessity for controlling these two members in such a manner r that a compression rate specified for the annular rib 27 or the like is kept to assume an adequate constant compression rate. The foregoing necessity will be described below with reference to Fig. 11.

Fig. 11 is a sectional view showing in an enlarged scale the state that two synthetic resin members having a diaphragm member clamped therebetween are welded together by employing a supersonic welding process. Referring to Fig. 11, an annular rib 63 formed around the peripheral part of an annular member 62 is clamped between a first synthetic resin member 60 and a second synthetic resin member 61. Here, when it is assumed that the first synthetic resin member 60 and the second synthetic resin member 61 substantially correspond to the members shown in Fig. 1, one member corresponds to the pump casing 24 and other member corresponds to the first cover 25 or the second cover 26. In addition, when it is assumed that the first synthetic resin member 60 and the second synthetic resin member 61 substantially correspond to the members shown in Fig. 10, one member corresponds to the first member 50 and other member corresponds to the second member 51. A contact location 64 situated outside of the position where the annular rib 63 is clamped between the first synthetic resin member 60 and the second synthetic resin member 61 corresponds to the position where the first synthetic resin member 60 and the second synthetic resin member 61 are welded together by employing the supersonic welding process. Specifically, when the first synthetic resin member 60 and the second synthetic resin member 61 are welded together by employing the supersonic welding process, this supersonic welding process is practiced such that, for example, the first synthetic resin member 60 is placed on a fixing jig (not shown), the second synthetic resin member 61 is subsequently placed on the fixing jig, and thereafter, the contact location 64 is subjected to supersonic welding while the second synthetic resin member 61 is squeezed in the downward direction by actuating a supersonic welding tool 65. When two thermoplastic resins each belonging to same kind are squeezed together in the opposite direction as they are subjected to supersonic welding, the contact location 64 serving as a common contact surface therebetween is melt by frictional heat, causing them to be welded together.

Here, in association with the second synthetic resin member 61, when a surface 67 is formed at the position where it is located opposite to an end surface 66 of the first synthetic member 60, and then, the second synthetic resin member 61 is squeezed in the downward direction, the end surface 66 of the first synthetic resin member 60 is brought in contact with the surface 67 of the second synthetic resin member 61, whereby the resultant contact surface serves as a stopper for preventing the welding operation from being excessively performed between the first synthetic resin member 60 and the second synthetic resin member 61.

With the structure as shown in Fig. 11 for preventing the supersonic welding operation from being excessively performed, when an excessive intensity of compressing force as well as an excessive intensity of supersonic energy are applied to the foregoing structure irrespective of the controlling operation performed for the welding time or when the aforementioned surfaces 66 and 67 each serving as a stopper have a small area, respectively, a phenomenon of melting appears on the contact surfaces, and consequently, a function for preventing the supersonic welding operation from being progressively performed is lost, with the result that there is a danger that the compression rate specified for the annular rib 63 can not be maintained. For this reason, to assure that the compression rate of the annular rib 63 is kept constant during each supersonic welding operation, there arises a necessity for taking special care of proper selection of an intensity of compressing power and an intensity of supersonic energy.

In addition, there are available means for preventing each supersonic welding operation from being excessively performed by controlling th welding time by actuating the supersonic welding tool 65, and moreover, by controlling a quantity of descending during the supersonic welding operation. However, since it is necessary to perform a confirming operation with respect to the compression rate specified for the annular rib 63 when a welding time and an extent of descending during each supersonic welding operation are preset, there arises a necessity for changing these preset conditions every time dimensions of certain component or member are caused to vary.

Here, description will be made below with respect to further improvement to be achieved according to the present invention.

Fig. 12 is a fragmentary sectional view of an essential part showing in an enlarged scale the state assumed prior to a supersonic welding operation. An annular groove 70 is formed on a first synthetic resin member 60, and additionally, an annular groove 71 located opposite to the annular groove 70 is formed around the outer periphery of the inner end surface of a second synthetic resin member 61, whereby an annular rib 63 extending around the outer periphery of a diaphragm member 62 is received in the annular groove 70 and the annular groove 71. One example wherein the annular rib 63 is formed over both the surfaces of the diaphragm member 62 is illustrated in Fig. 12. The annular rib 63 may be formed only on the one surface side of the diaphragm member 62 in the same manner as the case that the negative pressure fuel cock is constructed as shown in Fig. 10. Alternatively, either of the groove 70 and the groove 71 may be formed on the diaphragm member 62.

A first synthetic resin member 60 and a second synthetic resin member 61 are fitted to each other around an outer fitting portion 71 of each of the grooves 70 and 71. Surfaces 23 73 and 74 to be welded to the first synthetic resin member 60 and the second synthetic resin member 61 are formed adjacent to the fitting portion 71 in the opposing relationship. Since an outer end surface 75 of the first synthetic resin member 60 is located opposite to the supersonic welding tool 65, a gap 76 is formed between the outer end surface 75 and the supersonic welding tool 65 as shown in Fig. 12. While the first synthetic resin member 60 is placed on a fixing jig (not shown), and subsequently, the second synthetic resin member 61 is placed on the first synthetic resin member 60, the second synthetic resin member 61 is squeezed toward the first synthetic resin member 60 side in the downward direction with the aid of the supersonic welding tool 65 such as a supersonic horn or the like.

Fig. 13 is a fragmentary sectional view showing in an enlarged scale the state assumed after completion of the supersonic welding operation achieved for the first synthetic resin member 60 and the second synthetic resin member 61. When the second synthetic resin member 61 is squeezed in the downward directi n from the state shown in Fig. 12, the surface 73 and the surface 14 are welded together and the outer end surfac 75 of the first synthetic resin member 60 is br ught in contact with the supersonic welding tool 65, whereby the proceeding of the supersonic welding operation is interrupted, resulting in the state shown in Fig. 13 being assumed. Here, the compression rate specified for the annular rib 63 can be kept constant by presetting the foregoing gap to a predetermined distance. The contact surface defined by bringing the first synthetic resin member 60 in contact with the supersonic welding tool 65 should not be limited only to the formation of a continuous annular contour. Alternatively, a fragmentary contact surface may be formed on the first synthetic resin member 60.

Next, description will be made below with reference to Fig. 14 and Fig. 15 with respect to a synthetic resin assembly having a diaphragm member clamped in accordance with another embodiment of the present invention. Fig. 14 shows the state assumed prior to a supersonic welding operation, and Fig. 15 shows the state assumed after completion of the supersonic welding operation. Referring to Fig. 14, a metallic spacer 77 is placed in the space defined between an annular groove 70 formed in a first synthetic resin member 60 and an annular groove 71 formed in a second synthetic resin member 61. The first synthetic resin member 60 and the second synthetic resin member 61 are designed in such a manner that a gap 78 is formed between the metallic spacer 77 and the wall surface of the annular groove 71. When a supersonic welding operation is started from the state shown in Fig. 14 with the aid of a supersonic welding tool 65, the supersonic welding operation proceeds until the wall surface of the annular groove 71 comes in contact with the metallic spacer 77, whereby a surface 73 of the first synthetic resin member 60 and a surface 74 of the second synthetic resin member 61 are welded together. When the wall surface of the annular groove 71 comes in contact with the metallic space 77, further proceeding of the supersonic welding operation is interrupted, causing the supersonic welding operation to be completed. As a result, the state as shown in Fig. 15 is assumed by the first synthetic resin member 60 and the second synthetic resin member 61. At this time, a phenomenon of melting does not appear with the thermoplastic synthetic resin and the metallic material (metallic spacer 77) even though they are squeezed together in the opposite direction as supersonic vibration is induced by them.

To assure that an outer end surface 75 of the first synthetic resin member 60 is not brought in contact with the supersonic welding tool 65 before each supersonic welding operation is completed, the first synthetic resin member 60 and the second synthetic resin member 61 are designed in such a manner that a sufficiently large

magnitude of gap 76 is maintained therebetween. In addition, to assure that the magnitude of the gap 76 is not reduced to zero even after completion of the supersonic welding operation (see Fig. 15), the first synthetic resin member 60 and the second synthetic resin member 61 are designed in such a manner that the magnitude of the gap 76 is correctly predetermined.

Fig. 16 shows a synthetic resin assembly having a diaphragm member clamped in accordance with another embodiment of the present invention.

In the case as shown in Fig. 11, the synthetic resin assembly is constructed such that further proceeding of the supersonic welding operation is inhibitively suppressed by direct contact of the outer end surface 66 of the first synthetic resin member 60 with the surface 67 formed on the second synthetic resin member 61 at the time of completion of the supersonic welding operation. On the contrary, in the case of the synthetic resin assembly constructed in accordance with the embodiment of the present invention shown in Fig. 16, a metallic spacer 77 is interposed between an opposing surface 75 of the first synthetic resin member 60 and an opposing surface 79 of the second synthetic resin member 61. While the state assumed before completion of each supersonic welding operation is maintained, the metallic spacer 77 is not brought in contact with the opposing surface 79 of the second synthetic resin member 61. Thereafter, when the supersonic welding operation is progressively performed, causing the opposing surface 79 of the second synthetic resin member 61 to come in contact with the metallic spacer 77, this supersonic welding operation is completed (to assume the state shown in Fig. 16). In this connection, the height of the metallic spacer 77 is predetermined such that when the annular rib 63 is compressed until the constant compression rate of the annular rib 63 is obtained, further proceeding of the supersonic welding operation is interrupted.

As a result, when two synthetic resin members each having a diaphragm member including an annular rib around the peripheral part thereof in the clamped state are subjected to supersonic welding, the proceeding of the supersonic welding operation is caused to stop in the presence of the metallic spacer 77. Thus, the annular rib 63 of the diaphragm member 62 is compressed to assume a constant compression rate suitably employable for the supersonic welding operation, whereby an occurrence of excessive compression of the annular rib 63 can reliably be prevented.

[INDUSTRIAL APPLICABILITY]

With the synthetic resin assembly having diaphragm(s) clamped according to the present invention, since a main body and cover(s) are molded of a synthetic resin, fuel contained in the synthetic resin assembly is few heated on receipt of the heat generated by an engine. Consequently, the main body and the cover(s) each molded of a same kind of synthetic resin can be connected to each other by employing a welding process. Further, since any tightening operation is not required for allowing bolt members to extend through the main body and the cover(s), there does not arise a malfunction that creep deformation is induced in the main body and the cover(s).

In addition, the number of parts or components arranged in the synthetic resin assembly can be reduced not only by the omission of gaskets but also by the omission of bolt members or the like, and moreover, an inexpensive material of thermoplastic resin can be employed for the synthetic resin assembly, whereby a cost required for providing the main body and the cover(s) of the synthetic resin assembly can be reduced, and additionally, the number of man-hours required for building the synthetic resin assembly can be reduced, resulting in a cost required for producing the synthetic resin assembly being reduced. Further, the weight of the synthetic resin assembly can be reduced by the omission of bolt members or the like.

With the synthetic resin assembly having diaphragm(s) clamped according to the present invention, since there does not appear a phenomenon of melting between the thermoplastic resin and the metallic spacer, the supersonic welding tool or the metallic spacer can be used as a stopper for inhibitively suppressing further proceeding of the supersonic welding operation, whereby there does not arise a malfunction that the annular ribs formed for the diaphragm members are compressed in excess of a predetermined compression rate when two synthetic resin members are welded together.

Claims

1. A synthetic resin assembly having diaphragm member(s) clamped wherein a flexible diaphragm member is clamped between two members, and said diaphragm member(s) for forming a hollow space is clamped between one member and one flexible diaphragm member as well as between other member and other flexible diaphragm member, characterized in that a resin material is used for said two members, an annular rib is formed around the outer periphery of said flexible diaphragm member, a groove for receiving an annular rib for said flexible diaphragm member in the compressed state is formed on at least one of said two members, and said two members are welded together around the whole outer peripheral edge of said groove while said annular rib is received in said groove.

2. The synthetic resin assembly having diaphragm member(s) clamped as claimed in claim 1, characterized in that said flexible diaphragm member is formed by using a resin diaphragm, a number of small holes are formed through said flexible dia-

phragm member, said annular rib is formed by baking said resin diaphragm from both the surfaces of said resin diaphragm, and the both sides f said resin diaphragm are connected to each other via said small holes when said baking operation is performed so as not to allow said annular rib to be disconnected from said resin diaphragm.

3. The synthetic resin assembly having diaphragm member(s) clamped as claimed in claim 1, characterized in that other flexible diaphragm member is clamped for said one member with other member, two hollow spaces are formed between one member and other flexible diaphragm member, a resin material is used for forming said other member, an annular rib is formed around the outer periphery of said other flexible diaphragm member, a transverse rib transversely extending across said annular rib is formed to define said two hollow spaces, grooves each serving to receive an annular rib and a transverse rib in the compressed state are formed on one member and other member, and said one member and said other member are welded together around the whole outer periphery of one groove formed for one annular rib while said annular rib and said transverse rib are received in one groove.

4. The synthetic resin assembly having diaphragm member(s) clamped as claimed in claim 3, characterized in that said other flexible diaphragm member is formed by using a resin diaphragm, a number of small holes are formed through said resin diaphragm, said annular rib and said transverse rib are formed by baking said resin diaphragm from both surfaces of said resin diaphragm, and both sides of said resin diaphragm are connected to each other via said small holes at the time of said baking operation so as not allow said annular rib and said transverse rib to be disconnected from said resin diaphragm.

5. The synthetic resin assembly having diaphragm member(s) clamped as claimed in claim 1, characterized in that a certain surface held in the state isolated from a supersonic welding tool is formed on one synthetic resin member prior to a welding operation, further proceeding of a supersonic welding operation is inhibitively suppressed as said supersonic welding operation is progressively performed, and a compression rate specified for said annular rib is kept constant.

6. The synthetic resin assembly having diaphragm member(s) clamped as claimed in claim 1, characterized in that a metallic spacer is interposed between two synthetic resin members, hollow spaces are formed for one synthetic resin member as well as for said metallic spacer prior t a supersonic welding operation, said hollow spaces are caused to disappear as said supersonic welding operation is progressively performed, further proceeding of said supersonic welding operation is inhibitively suppressed by allowing said metallic spacer to come in contact with one synthetic resin member, and a compression rate specified for said annular rib is kept constant.

7. The synthetic resin assembly having diaphragm member(s) clamped as claimed in claim 6, characterized in that said metallic spacer is interposed between said two synthetic resin members in one groove formed in each of two synthetic resin members.

FIG. 1

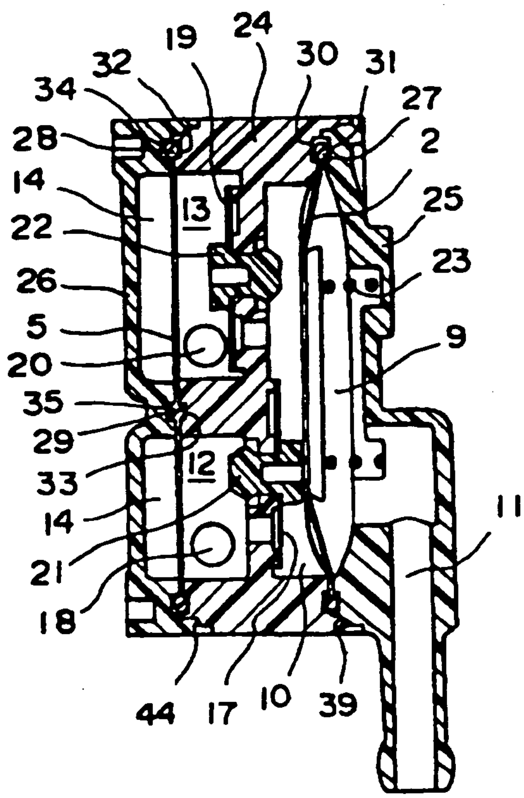

19
24
32
34
30
31
27
28
2
14
13
25
22
23
26
5
9
20
35
29
12
33
14
11
21
18
44
17
10
39

FIG. 2

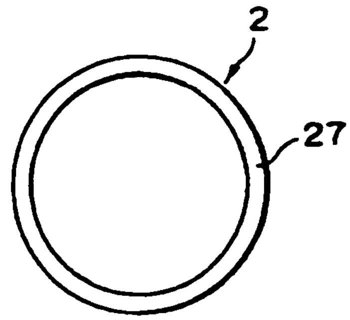


FIG.3

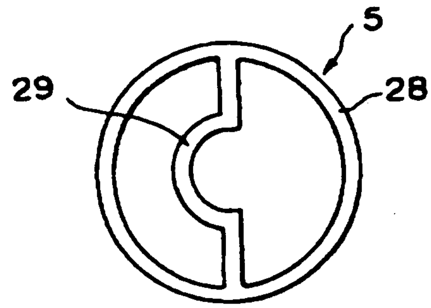


FIG. 4

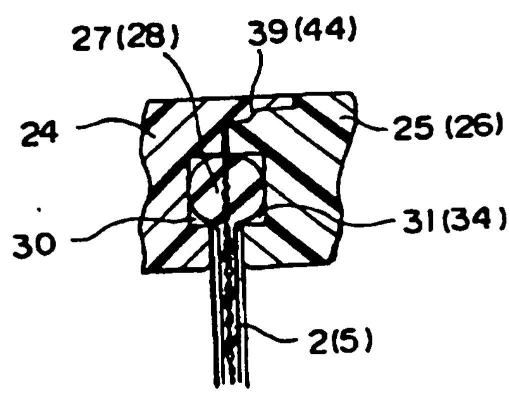


FIG. 5

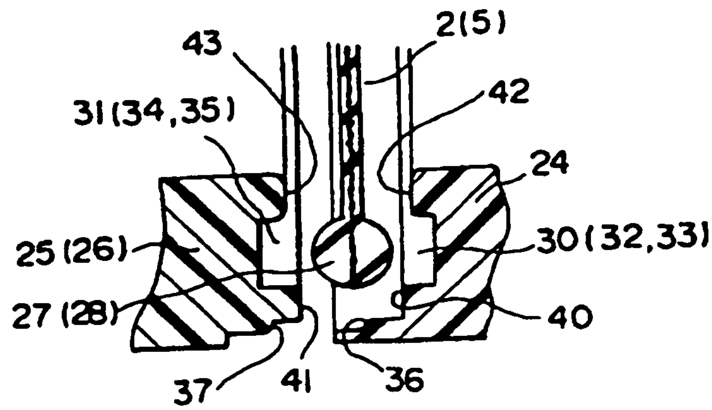


FIG. 6

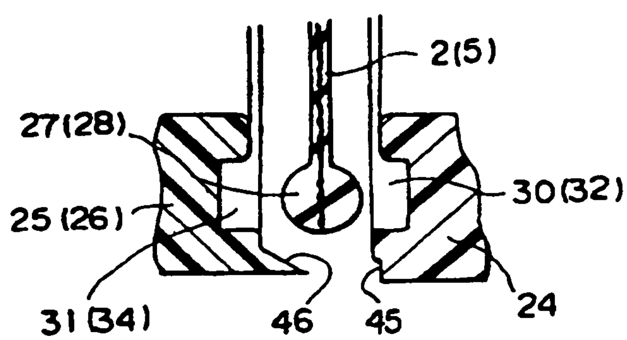


FIG. 7

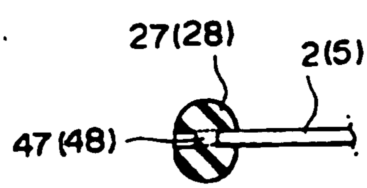


FIG. 8

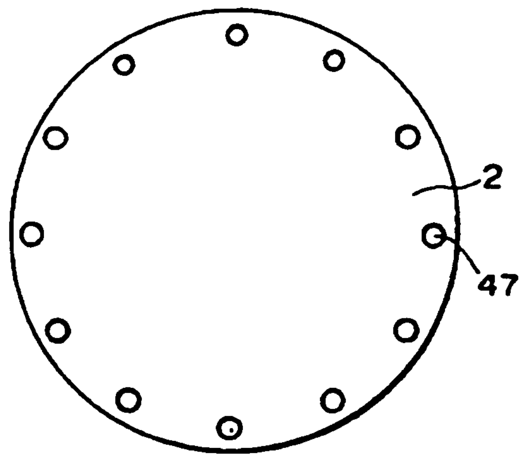


FIG. 9

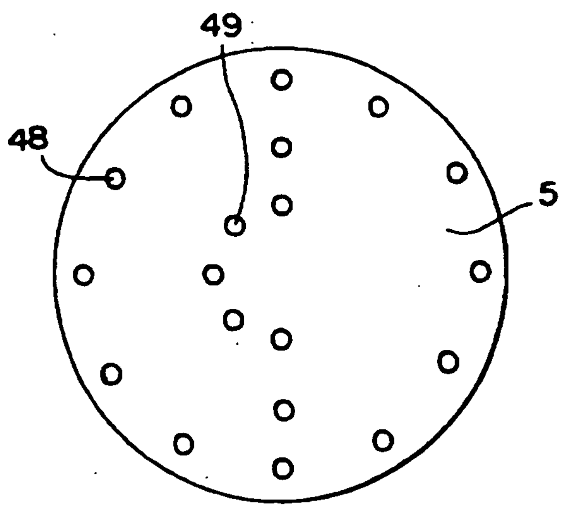


FIG. 10

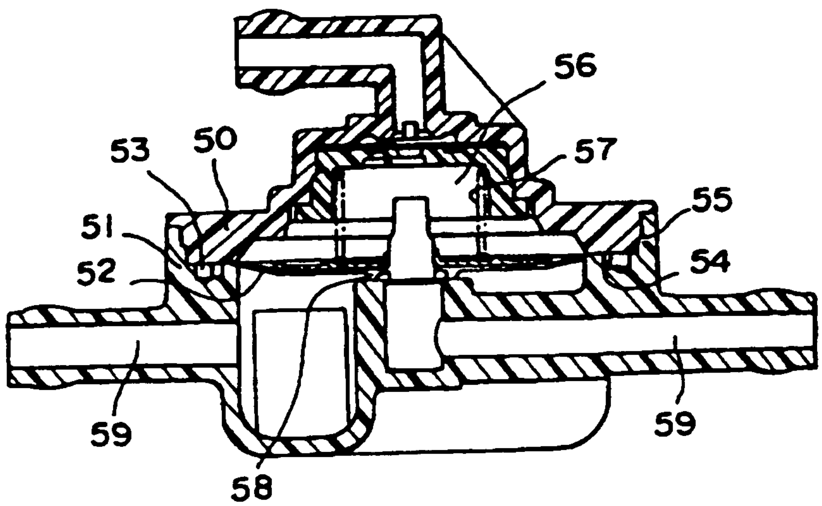


FIG. 11

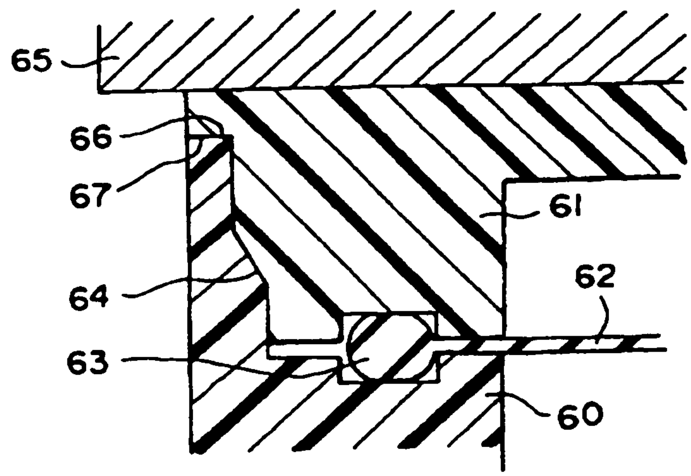


FIG. 16

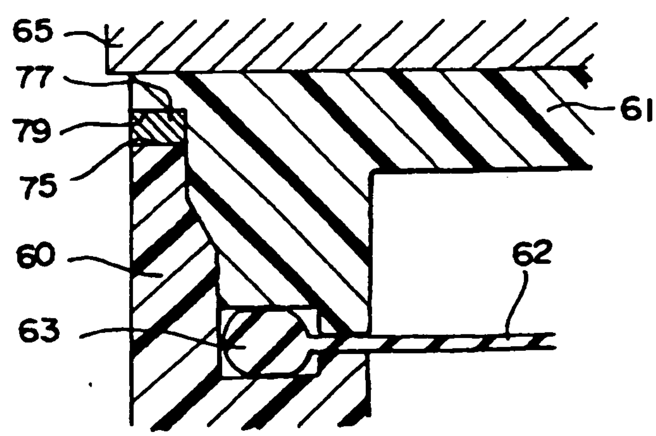


FIG. 12

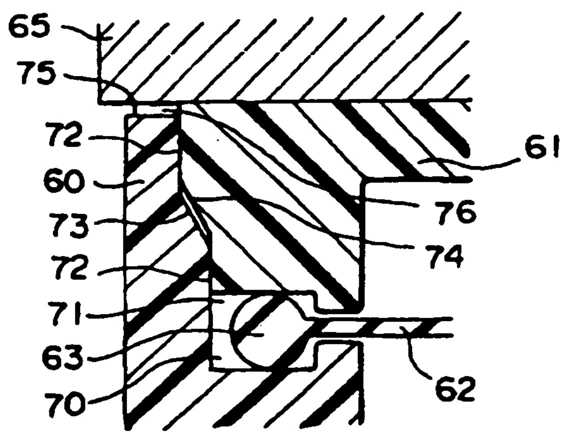


FIG. 13

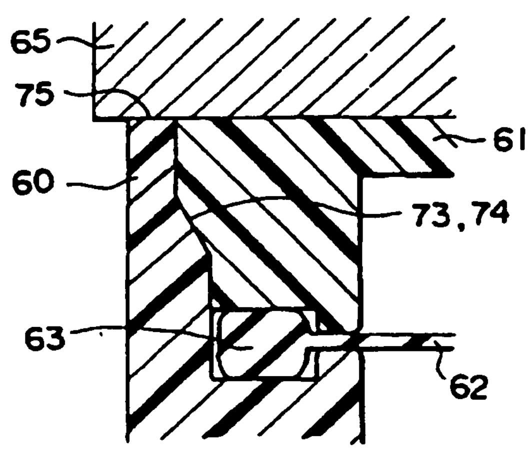


FIG. 14

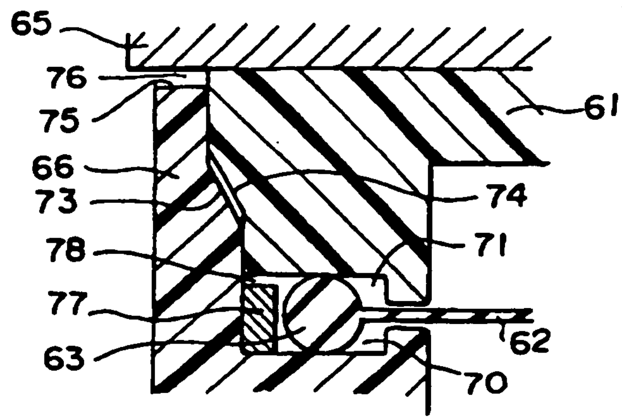


FIG. 15

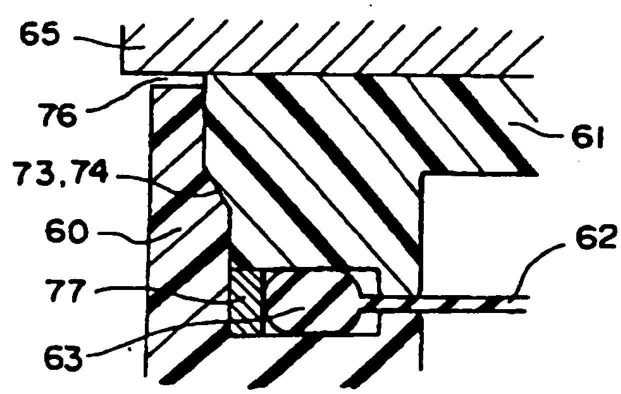
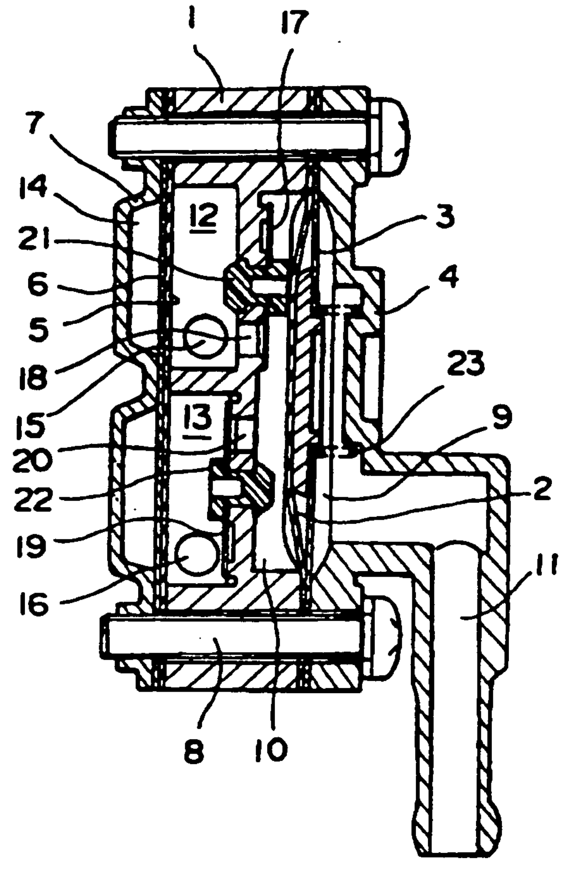


FIG. 17



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP97/00375

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 F02M37/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^6 F02M37/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1966 - 1997
Kokai Jitsuyo Shinan Koho 1971 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the written application of Japanese Utility Model Application No. 107871/1981 (Laid-open No. 37979/1983)(Tsuchiya Mfg. Co., Ltd.), March 11, 1983 (11. 03. 83), Particularly Fig. 1 (Family: none)	1 - 7
Y	Microfilm of the specification and drawings annexed to the written application of Japanese Utility Model Application No. 129795/1989 (Laid-open No. 68580/1991)(Keihin Seiki Mfg. Co., Ltd.), July 5, 1991 (05. 07. 91), Claim; Fig. 1 (Family: none)	1 - 7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
May 9, 1997 (09. 05. 97)	May 20, 1997 (20. 05. 97)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)